National Aeronautics and
Space Administration

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The **MOON**, Earth's only natural satellite, is unusually large in relation to its planet, having a diameter roughly 1/4 that of Earth's. Thus, the two bodies are sometimes referred to as a double-planet system. This situation suggests an unusual origin for the Moon. Some proposed origin theories include separation from Earth, independent formation, and capture from elsewhere in the solar system. The theory that seems to explain most of our observations, however, is that a Mars-sized body once hit Earth and the resulting debris (from both Earth and the impacting body) accumulated to form the Moon. Whatever the origin, we know the Moon was formed over 4.5 billion years ago (the age of the oldest collected lunar rocks).

During the Moon's formation, very high temperatures caused extensive melting of its outer layers. The melting resulted in the formation of the lunar crust, probably from a planet-wide "magma ocean." The rocks found on the Moon's highlands are at least 4.5 billion years old, and are rich in light-colored minerals, called feldspar. These rocks, called anorthosites, give the lunar highlands their bright color. In the years since the rocks were formed, innumerable meteorites have hit the Moon, producing a crust that is intensely crated and fragmented.

About 4 billion years ago, a series of major impacts occurred, forming huge craters. These craters are now the sites of basins called maria (e.g., Mare Imbrium, Mare Serenitatis). Between 4 and 2.5 billion years ago, volcanic activity filled these basins with dark-colored lavas, called basalts. After this time of volcanism, the Moon cooled down, and has since been relatively inactive, except for the occasional "hits" of meteorites and comets. The Moon has not undergone the continual mountain-building associated with the movement of crustal plates and volcanic activity that characterized Earth; it is a fossil planet on which the earliest stages of geologic evolution are preserved.

The Moon, however, is not completely inactive. Seismometers emplaced by the Apollo astronauts have recorded small quakes (more properly called "moonquakes") at depths of several hundred kilometers. The quakes are probably triggered by tides resulting from Earth's gravitational pull. Small eruptions of gas from some craters, such as Aristarchus, have also been reported. Local magnetic areas have been detected around craters, but there is no planet-wide magnetic field resembling Earth's. It has also been determined that the deep interior of the Moon is still hot and perhaps partially molten.

The Moon's shape is unusual. It is slightly eggshaped, with the small end of the "egg" pointing toward Earth. This position causes the Moon to keep the same face toward Earth at all times. The far side, which cannot be observed from Earth, has days and nights just like those on the near side. The lunar gravity field is also unusual.
A surprising discovery from the tracking of the Lunar Orbiter photographic spacecraft in the 1960's revealed strong areas of high gravitational acceleration located over the circular maria.

The "mascons" (mass concentrations) are thought to be caused by layers of denser, basaltic lavas that fill the mare basins. Much remains to be learned about our Moon, beginning with its origin. Active research still continues to yield information about our nearest neighbor in space using the samples and data returned by Apollo and other missions. Speculation has begun on how the Moon might be used to support lunar bases and other human activities in the next century.

Fast Facts

Diameter	3,476 Kilometers
Mass	1/81 the /mass of Earth
Density	3.3 Grams/Cubic Centimeter
Rotation Period	27.3 Days
Surface Gravity	1/6 g
Escape Velocity	2.4 Kilometers/Second
Oldest Rocks	4.5 Billion Years
Atmosphere	None

Significant Dates

1610—Italian astronomer Galileo Galilei made the first telescopic observations of the Moon.
1959—Soviet spacecraft Luna 2 reached the Moon, impacting near the crater Autolycus.
1959—Soviet spacecraft Luna 3 flew by the moon and photographed the far side for the first time.
1961—President John F. Kennedy proposed a manned lunar program.
1964—Ranger 7 produced the first close-up TV pictures of the lunar surface.
1966—Luna 9 made the first soft landing on the Moon.
1967—Lunar Orbiter missions completed photographic mapping of the Moon (begun in 1966).
1968—Apollo 8 made the first manned flight to the Moon, circling it 10 times before returning to Earth.
1969—Apollo 11 mission made the first manned (human crew) landing on the Moon and return samples.
1972—Apollo 17 made the last manned landing of the Apollo Program.
1976—Soviet Luna 24 returned the last sample of the Moon.
1990—Galileo spacecraft obtained multispectral images of the western limb and part of the far side of the Moon.
1994—Clementine mission conducted multispectral mapping of the Moon.
1998—Lunar Prospector will survey mineral composition of the Moon.

About the Image

This photograph of the Moon was taken in December 1972 by the Apollo 17 mission—shortly after the spacecraft left the Moon to return to Earth. The view shows the full Moon. The region at the right (about two-thirds of the total) is part of the Moon's far side, the side never seen from Earth. The dark regions are the maria, which are covered with dark-colored basalt lava flows. The dark, nearly circular mare region at the upper left is called Mare Crisium. Below it and to the left is Mare Fecunditatis, with the large white crater Langrenus. The light-colored regions are the lunar highlands, which are made of older rocks and contain extensive large craters made by large projectiles that struck the Moon more than 4 billion years ago. The bright, rayed crater near the upper-right rim is Giordano Bruno, a fresh crater formed by a much younger impact event.

References
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